cannulation), insertion of chest tubes, pericardiocentesis, and so on.
4. Utilization of more advanced cardiovascular pharmacologic therapy (e.g., esmolol for therapy of hypertension, vasopressin for therapy of hypotension).
5. Advanced skills in evaluation and treatment of arrhythmias (e.g., utilization of epicardial electrodes and transesophageal leads for diagnosis and treatment of rhythm abnormalities, use of pharmacologic agents to treat arrhythmias, and so on).
6. Advanced management of pulmonary hypertension.
7. Diagnosis and treatment of less frequently encountered/more complex postoperative complications, including lesion-specific complications. Such complications include significant residual cardiac lesions, paralyzed hemidiaphragm(s), large airway obstruction, compartment syndrome following femoral arterial cannulation for cardiopulmonary bypass, prolonged chest tube drainage, and so on. The practitioner should be familiar with indications for invasive evaluation (e.g., heart catheterization or bronchoscopy) and invasive therapy (e.g., additional cardiac surgery, interventional catheterization, tracheostomy).
8. Evaluation and management of multisystem organ failure.
9. Postoperative management of orthotopic heart transplant patients, and management of acute rejection.
10. Diagnosis and management of renal failure, including indications for renal replacement therapy.
11. Diagnosis and management of forms of neurological dysfunction, sometimes seen in patients with critical heart disease (seizures, stroke, global ischemia, increased intracranial pressure).
12. Available means of providing nutritional support, and the most appropriate means for a given patient.
13. Transfusion management, and recognition and treatment of common transfusion-related complications.

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APPENDIX

Dr. David L. Wessel declared that he had the following relationships with industry relevant to this topic—Pfizer (consultant and research grant); INO Therapeutics (consultant and scientific advisory board). The other authors of this report declared that they have no relationships with industry pertinent to this topic.

Task Force 6: Training in Transition of Adolescent Care and Care of the Adult With Congenital Heart Disease

Daniel J. Murphy, Jr, MD, FACC, FAAP, *Chair*, Elyse Foster, MD, FACC, FAHA

INTRODUCTION

The number of adults with congenital heart disease (CHD) has increased significantly over the past 20 years. Palliative surgery and, more recently, non-surgical and medical interventions have permitted even those with the most complex lesions to reach adulthood. The recent Bethesda Conference estimated that there are approximately 420,000 CHD patients in the U.S., based on models that exclude simple congenital lesions such as bicuspid aortic valve, small atrial or ventricular septal defect, and mild pulmonary stenosis. Of those patients, approximately three-fourths have lesions that are moderately complex and one-fourth have lesions of great complexity.

Establishing an adequate system for the care of these individuals is a challenging task that can best be accomplished through an integrative approach that draws on the skills and knowledge base of both pediatric and medical (adult) cardiologists within an adult CHD center. Many adults with CHD continue to be cared for by pediatric cardiologists, who are well trained to deal with the often complex problems associated with CHD, but are generally unprepared to manage unique problems of adults with CHD, including long-term complications and adult health care issues such as pregnancy and overlay of acquired disease. Thus, basic knowledge of issues unique to adults with CHD as well as knowledge of the indications for referral to a specialized adult CHD (ACHD) center is required of all pediatric cardiologists.

The American College of Cardiology (ACC) has published training guidelines for Adult Cardiovascular Medicine Core Cardiology Training II (COCATS 2) which include recommendations regarding care of adult patients with CHD. These recommendations were developed with the recognition that appropriate training and education for adult cardiologists is currently deficient in CHD, but that eventually the numbers and complexity of such adult patients will demand that many be cared for in adult settings by cardiologists with an internal medicine-adult cardiology background (1). It will be at least a decade or more before the graduates of adult cardiology training programs are sufficiently

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numerous and adequately trained to staff specialized adult congenital centers as recommended in the 32nd Bethesda Conference (2). Medical/pediatric residents with double boards in adult and pediatric cardiology would provide excellent training to care for these patients. Meanwhile, for the foreseeable future, significant numbers of adults will need to receive all or a part of their cardiac care from pediatric cardiologists with training in adult issues.

Even if in the future the majority of adults with CHD are cared for in specialized ACHD centers, staffed primarily by specially trained adult cardiologists, there are compelling reasons for the pediatric cardiology training curriculum to address issues relating to ACHD. The Bethesda Conference recommended that such centers maintain a liaison with pediatric cardiology programs for purposes of patient care, education, and support. For example, as surgical treatments evolve, the postoperative course changes, requiring new forms of surveillance and follow-up; the lessons learned from adolescents will shape the care of adults with CHD, and only close coordination between pediatric cardiologists and specialists in ACHD will optimize that care.

This report suggests an approach to the training of pediatric cardiologists. These guidelines will emphasize the importance of preparing young patients with CHD for transition to adult care, the need for pediatric cardiologists to understand the outcomes of CHD in the adult patient, and will serve as a guide for pediatric cardiologists who will participate directly in the care of adults with CHD.

LEVELS OF TRAINING

Core Training (Level 1)

We differentiate three levels of training and expected expertise in the care of adults with CHD. Core training represents the level of knowledge appropriate for all trainees in pediatric cardiology and indicates the knowledge content that each graduate of such a program should acquire. This level of knowledge should be tested in the Subspecialty Certification Examination in Pediatric Cardiology and will provide the graduate with sufficient expertise to care for adolescents with CHD and prepare them for transition to ACHD care. In addition to the basic science and clinical knowledge included in every pediatric cardiology curriculum, certain additional knowledge areas should be included:

- general knowledge
- natural history of cardiac defects
- postoperative residua, long-term issues
- understanding care in the adult setting
- transition issues
- adolescent medicine
- outpatient experience
- lectures as part of core curriculum
- indications for and access to local/regional expert consultation
- adolescent and young adult medical care issues
- contraception, gynecologic issues, pregnancy
- physical activity, sports, and activity counseling
- education, health and general
- insurability
- employment
- psychosocial issues

Advanced Training (Level 2): Special Expertise in Adults With CHD

The COCATS 2 guidelines for adult cardiology fellows suggest at least one year of concentrated exposure for those trainees who wish to care independently for adult patients with CHD. Certain knowledge areas should be included:

Basic science. Pathophysiology of acquired heart disease with a strong emphasis on heart failure, arrhythmias, and coronary atherosclerosis.

Adult medical care issues.

- coronary artery disease, hypertension, lipid management, chronic obstructive pulmonary disease
- contraception, gynecologic issues, management during pregnancy and delivery
- physical activity, sports, and activity counseling
- education, health and general
- insurability
- employment
- psychosocial issues
- palliative care

In addition to didactic materials, training should include the following activities and aims:

- Participation in a regular (at least weekly) clinic organized for the care of adults with CHD—at least 10 patients per week; and participation in the perioperative care of adult patients with CHD including direct observation of surgical repair.
- Program requirements.

To train effectively at level 2, a pediatric cardiology program should include at least one faculty member with a career commitment to the care of adult patients with CHD.

Advanced Training (Level 3): Advanced Expertise in Adults With CHD

The COCATS 2 guidelines recommend an additional year of continued participation in clinical practice relating to ACHD to achieve advanced level 3 training. In addition to the guidelines for advanced level 2 training, level 3 should include active participation in clinical and/or laboratory research in conjunction with clinical activities and direct participation in additional cardiac catheterization and echocardiographic procedures in adults with CHD.

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APPENDIX

The authors of this section declare they have no relationships with industry pertinent to this topic.

Task Force 7: Training Guidelines for Research in Pediatric Cardiology

D. Woodrow Benson, Jr, MD, PhD, *Chair*, H. Scott Baldwin, MD, FACC, FAHA, Larry T. Mahoney, MD, FACC, FAHA, Tim C. McQuinn, MD, FAAP

Historically, pediatric cardiology has been a dynamic clinical field where a rapid transfer of knowledge from the research laboratory to the bedside occurred regularly. Conversely, many problems on which laboratory effort was focused were first identified at the bedside. This pattern continues today, and there is every reason to believe it will accelerate in the future. Research in pediatric cardiology is defined in broad terms because it is anticipated that future advances in the care of pediatric patients with cardiovascular disease will go beyond current practice and come from diverse areas of biomedical science. If the pediatric cardiologist is to maintain clinical competence and improve clinical knowledge in step with the progress of biomedical science, it is crucial that he or she thoroughly understands the concepts, methods, and pitfalls of the research process. It is important that every pediatric cardiology trainee participate directly in research as training that is limited to practical experience can teach only the status quo, and the status quo cannot improve patient care. The guidelines that follow are based in part on recommendations published in 1995 and revised in 2002 (1,2) and a Task Force Report on Pediatric Cardiovascular Diseases (3).

In addition to direct involvement in research, every trainee should gain practical experience in review of published data, research design, data analysis, and logical deduction. The research experience plays a unique role in developing the skills in continuing self-education essential to all pediatric cardiologists. Trainees contemplating a career in investigative cardiology bear a special responsibility to prepare effectively to advance understanding in the broad area of clinical, translational, and basic cardiovascular science as well as population science, behavioral science, quality of care, and outcomes research.

Because the research experience is such an integral component, pediatric cardiology training should be carried out in institutions in which the opportunity to participate in research is available. The training site should be one that provides an atmosphere of intellectual inquiry and support of the investigational process.

GENERAL STANDARDS

The training institution must have staff and facilities for research. Opportunities for research for the trainees should be available not only within the clinical cardiology division, but also within biomedical science, epidemiological, or other clinical programs of the institution. Availability of expertise in cardiac development, cardiovascular genetics, epidemiology, outcome evaluation, biostatistics, population science, behavioral science, quality of care, outcomes research, and biomedical ethics should be readily available. There should be a critical mass of investigators, and it is expected that cardiovascular investigation be well represented. Not all investigators need to be clinical cardiologists, but at least one full-time faculty member from each training program should have demonstrated skill and research productivity as an investigator.

DURATION OF RESEARCH TRAINING

For trainees planning careers in education and patient care, the core research training should include substantial research time devoted to a specific research project or projects. In most cases, this will encompass a full 12 months of the training period. For those planning a career with a major emphasis on investigation, an additional one to two years